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ABSTRACT

The purpose of this study is to evaluate present provisions for the financing of school transportation in Tennessee. It includes the following: (1) an analysis of variations among Tennessee districts in the per pupil costs of transportation, (2) an evaluation of the factors that cause variations in per pupil costs that are beyond the control of boards of education, (3) an evaluation of the present formula being used in Tennessee to allocate state funds for pupil transportation services, (4) the development of an improved formula for allocating state funds for pupil transportation services if the present formula is found to be inequitable, and (5) a projection of the impact of any proposed formula on the school districts of Tennessee. Recommendations and numerous tables are included. (Author/IRT)

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THE FUNDING OF SCHOOL TRANSPORTATION IN TENNESSEE

A STUDY MADE FOR
THE TENNESSEE SCHOOL FINANCE
EQUITY STUDY

BY

THE EDUCATIONAL FINANCE AND
MANAGEMENT INSTITUTE, INC.
GAINESVILLE, FLORIDA

ROE L. JOHNS, DIRECTOR OF
TRANSPORTATION STUDY

1978

EA 012 290

FOREWORD

This report is the product of one in a series of studies initiated by the Tennessee School Finance Equity Study Project as part of a detailed review of the State's program for financing the public schools, kindergarten through grade twelve. It presents an analysis of school transportation costs and State funding of school transportation costs in Tennessee with alternative formulas for the allocation of State funds for school transportation. Neither the findings, the implications, the conclusions, nor the recommendations are necessarily those supported by the Study Project, the State Department of Education, or the Joint Legislative Committee on Elementary/Secondary School Finance all of whom are cooperating in sponsoring the overall study. This report represents a part of a larger body of knowledge which is being gathered by the Study Project so that viable alternatives can be examined and considered upon their merits. This study along with others conducted for the School Finance Equity Study Project is funded by the U.S. Office of Education, Department of Health, Education and Welfare, under Section 842 of P.L. 93-380. However, the opinions expressed do not necessarily reflect the position or policy of the U.S. Office of Education.

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September, 1978

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STATE FUNDING OF SCHOOL TRANSPORTATION IN TENNESSEE

State funding of school transportation is more inadequate in Tennessee at the present time than previously. Data presented in the annual statistical reports of the Tennessee State Department of Education show the following: In 1964-65, the state allocation for school transportation amounted to 78.8 percent of actual expenditures for transportation; it amounted to 41.3 percent in 1974-75; 37.5 percent in 1975-76; and 34.2 percent in 1976-77. Since the total state allocation for transportation in 1977-78 is only $15,072,971 as compared with $13,990,018 in 1976-77, the percent of total expenditures for transportation provided by the state allocation is probably no greater in 1977-78 than in 1976-77 because total expenditures for transportation in 1977-78 have probably increased as much proportionately as the state allocation.

School transportation is essential to the provision of a modern program of public education. At the present time 52 percent of all the public school pupils in the nation are transported to school. In Tennessee, 62 percent of the public school pupils are transported to school. School transportation is necessary in order to bring enough pupils to school centers to have reasonable economies of scale in providing the educational programs needed. This is especially true for secondary schools and for vocational education and the education of the handicapped.

Fifty years ago, practically all school transportation was for the purpose of transporting rural farm pupils to consolidated or town schools. However, there has been a national trend for people to migrate from the

central cities to the surrounding territory. Therefore, at the present time there are more rural non-farm pupils being transported to school than rural farm pupils. This trend coupled with increased transportation for vocational students and the handicapped and transportation to provide racial balance among the schools of a district is likely to result in further increases in the percent of pupils transported.

The burden of financing school transportation does not bear equally on the school districts of Tennessee. Data presented in the 1975-76 report of the Tennessee State Department of Education show that total state expenditures for school transportation amount to 4.7 percent of the total state current expenditures for the public schools. But in Hickman County, expenditures for school transportation amounted to 11.5 percent of current expenditures; in Hancock County, 9.8 percent; in Grundy County, 8.7 percent; in the Knoxville city system, two-tenths of 1 percent; and in the Chattanooga city system, 3.1 percent. Therefore, inadequate state funding of school transportation places unequal financial burdens on the school districts of a state.

All states are faced with the problems of determining the total amount of state funding of transportation needed and how to allocate that fund among the school districts of the state in order to maximize the equalization of educational opportunity. Tennessee is faced with these same problems at the present time. The purpose of this study is to evaluate present provisions for the financing of school transportation in Tennessee. It includes the following:

1. An analysis of variations among the districts of Tennessee in the per pupil costs of transportation,

2. An evaluation of the factors beyond the control of boards of education causing variations in per pupil costs,
3. An evaluation of the present formula being used in Tennessee to allocate State funds for pupil transportation services,
4. The development of an improved formula for allocating State funds for pupil transportation services if the present formula is found to be inequitable, and
5. A projection of the impact of any proposed formula on the different school districts of Tennessee.

ANALYSIS OF DATA

Table 1 shows the total program costs for transportation, the average daily attendance of transported pupils[1] who live more than 1½ miles from school, and the average per pupil cost for each county. The total program cost includes operating expenditures plus depreciation cost of district-owned vehicles computed at one-tenth of replacement cost. It is necessary to add depreciation costs to operation costs in districts which own their school buses in order to make their per pupil costs comparable with districts which contract for their school transportation.

It is noted from Table 1 that operating costs range from a low of $55.64 per pupil in Campbell County to a high of $150.34 in Perry County. Numerous studies have shown that per pupil costs of school transportation vary due to a factor or factors beyond the control of the board of education and due to many factors subject to the control of the board of education. Research has shown that the principal factor beyond the control of

TABLE 1

PUPIL TRANSPORTATION EXPENDITURES INCLUDING ESTIMATES OF CAPITAL OUTLAY NEEDS
1976-77 TABLE XIV, ASR, pp. 108-9; TABLE XXX, pp. 176-79, ASR:
TABLE XXXI, ASR, pp. 180-83; TABLE XXXII, ASR, pp. 184-87
(Data provided by Tennessee State Department of Education)

1 County Including Cities	2* (Reported) Operation Costs	3** (Estimated) Replacement Costs	4 (Col. 2+3) Total Program Costs	5 (1½+miles) ADT Pupils	6 (Col. 4+5) Per Pupil Cost
1. Anderson	$ 683,828		$ 683,828	7,041	$ 97.12
2. Bedford	212,008	70,200 (2)	282,208	3,769	77.12
3. Benton	208,588		208,588	2,495	83.60
4. Bledsoe	137,418	31,200 (2)	168,618	1,577	106.92
5. Blount	723,767		723,767	10,961	71.93
6. Bradley	537,178		537,178	7,423	72.36
7. Campbell	342,565		342,565	6,156	55.64
8. Cannon	143,639		143,639	1,295	110.91
9. Carroll	265,974	67,600 (2)	333,574	4,127	80.82
10. Carter	375,104	89,700 (2)	464,804	6,593	70.38
11. Cheatham	222,365	64,400 (3)	286,765	3,789	75.68
12. Chester	137,271	32,500 (3)	169,771	2,176	78.01
13. Claiborne	346,194		346,194	4,607	75.14
14. Clay	112,764	28,600 (2)	141 364	1,428	98.99
15. Cocke	377,282	66,300 (2)	443,582	4,276	103.73
16. Coffee	184,752	53,300 (2)	238,052	2,774	85.81
17. Crockett	106,485	32,500 (2)	138,985	2,248	61.82
18. Cumberland	300,541	70,200 (2)	370,741	4,420	83.87
19. Davidson	4,515,672	642,600 (4)	5,158,272	37,776	136.54
20. Decatur	173,712		173,712	1,665	104.33
21. DeKalb	157,217	45,500 (2)	202,717	2,188	92.64
22. Dickson	340,235	76,700 (2)	416,935	4,741	87.94
23. Dyer	225,118	57,200 (2)	282,318	3,189	88.52
24. Fayette	378,869	84,00 (3)	462,869	5,127	90.28

TABLE 1 (continued)

1 County Including Cities	2* (Reported) Operation Costs	3** (Estimated) Replacement Costs	4 (Col. 2+3) Total Program Costs	5 (1½+miles) ADT Pupils	6 (Col. 4+5) Per Pupil Cost
25. Fentress***	149,487	44,200 (3)	193,687	2,848	68.00
26. Franklin	374,630		374,630	4,886	76.67
27. Gibson	359,695	79,800 (2)	439,495	5,316	82.67
28. Giles	392,620	87,100 (2)	479,720	3,758	127.65
29. Grainger	193,660		193,660	3,021	65.10
30. Greene	527,241	128,700 (2)	655,941	8,917	73.56
31. Grundy	165,170	27,600 (1)	192,770	2,019	95.47
32. Hamblen	256,364	49,400 (2)	305,764	5,143	59.45
33. Hamilton***	2,386,734	137,200	2,523,934	26,334	95.84
34. Hancock	105,770		105,770	1,158	91.33
35. Hardeman	299,967	88,200 (3)	388,167	4,203	92.35
36. Hardin	254,851	75,600 (3)	330,451	3,334	99.11
37. Hawkins	423,722	104,000 (2)	527,722	7,233	72.96
38. Haywood	315,895		315,895	3,944	80.09
39. Henderson	244,159		244,159	3,065	79.66
40. Henry	369,440	88,200 (3)	457,640	3,945	116.00
41. Hickman	249,991	54,600 (2)	304,591	2,546	119.63
42. Houston	73,117	15,600 (2)	88,717	1,173	75.63
43. Humphreys	221,244	54,600 (2)	275,844	2,844	96.99
44. Jackson	146,790		146,790	1,637	89.67
45. Jefferson	278,338	58,500 (2)	336,838	5,573	60.44
46. Johnson	201,671	45,600 (1)	247,271	2,451	100.88
47. Knox	2,008,590		2,008,590	31,716	63.33
48. Lake	72,410	15,400 (3)	87,810	909	96.60
49. Lauderdale	182,808	57,200 (2)	240,008	4,113	58.35
50. Lawrence	366,865	89,600 (3)	456,465	4,940	92.40
51. Lewis***	89,063	28,600 (2)	117,663	1,287	91.42
52. Lincoln	274,948	72,800 (2)	347,748	3,360	103.49

TABLE 1 (continued)

1 County Including Cities	2* (Reported) Operation Costs	3** (Estimated) Replacement Costs	4 (Col. 2+3) Total Program Costs	5 (1½+miles) ADT Pupils	6 (Col. 4+5) Per Pupil Cost
53. Loudon	$ 276,401	$	$ 276,401	3,349	$ 83.53
54. McMinn	367,163	91,000 (2)	458,163	6,465	70.86
55. McNairy	315,059	68,900 (2)	383,959	3,983	96.39
56. Macon	196,298	55,200 (1)	251,498	2,450	102.65
57. Madison	517,357	121,800 (3)	639,157	6,660	95.96
58. Marion	327,109		327,109	3,244	100.83
59. Marshall	196,066	53,300 (2)	249,366	2,246	111.02
60. Maury	348,346	96,600 (3)	444,946	6,310	70.51
61. Meigs	78,940	20,800 (2)	99,740	1,463	68.17
62. Monroe	381,600		381,600	3,808	100.21
63. Montgomery	689,935	156,000 (2)	845,935	11,832	71.49
64. Moore	59,900	16,800 (1)	76,700	836	91.74
65. Morgan	204,152	44,400 (1)	248,552	2,965	83.82
66. Obion	229,418	75,400 (2)	304,818	3,100	98.32
67. Overton	209,723	54,000 (1)	263,723	3,039	86.77
68. Perry	126,293		126,293	840	150.34
69. Pickett	56,052	18,000 (1)	74,052	743	99.66
70. Polk	267,399	46,000 (1)	313,399	2,578	121.56
71. Putnam	262,262	89,600 (3)	351,862	4,859	72.41
72. Rhea	206,067	52,000 (2)	258,067	3,108	83.03
73. Roane	392,993	79,300 (2)	472,293	5,140	91.88
74. Robertson	329,313	49,200 (2)	378,513	5,140	73.64
75. Rutherford	690,771		690,771	10,379	66.55
76. Scott	239,912	49,200 (1)	289,112	3,744	77.22
77. Sequatchie	135,784	24,700 (2)	160,484	1,515	105.93
78. Sevier	415,700	105,600 (1)	521,300	5,836	89.32
79. Shelby***	5,459,666	226,800 (3)	5,686,466	39,550	143.77
80. Smith	183,666	38,400 (1)	222,066	2,257	98.38

TABLE 1 (continued)

1 County Including Cities	2* (Reported) Operation Costs	3** (Estimated) Replacement Costs	4 (Col. 2+3) Total Program Costs	5 (1½+miles) ADT Pupils	6 (Col. 4+5) Per Pupil Cost
81. Stewart	148,785	37,700 (2)	186,485	1,529	121.96
82. Sullivan	1,178,488		1,178,488	16,585	71.05
83. Sumner	814,029	205,800 (3)	1,019,829	13,416	76.01
84. Tipton	345,934	83,200 (2)	429,134	5,783	74.20
85. Trousdale	71,218	23,400 (2)	94,618	974	97.14
86. Unicoi	88,738	24,700 (2)	113,438	1,681	67.48
87. Union	185,621		185,621	2,228	83.31
88. Van Buren	63,099	13,200 (1)	75,299	835	90.17
89. Warren	287,213	75,400 (2)	362,613	4,849	74.78
90. Washington	499,609	166,400 (2)	666,009	10,089	66.01
91. Wayne	206,348	49,200 (1)	255,548	2,603	98.17
92. Weakley	238,089	81,900 (2)	319,989	3,420	93.56
93. White	181,009	55,900 (2)	236,909	3,079	76.94
94. Williamson	442,798	121,800 (3)	564,598	6,562	86.04
95. Wilson	459,542	114,800 (3)	574,342	6,774	84.78
TOTAL	40,566,651	5,601,400	46,168,051	510,350	90.46

*Includes handicapped and vocational education transportation expenditures from Tables XXX and XXXI, ASR, 1976-77; excludes vehicle replacement costs reported in Table XXXII, ASR, 1976-77.

**Estimate based on the following unit prices: (1) 54 capacity, $12,000; (2) 60 capacity, $13,000; (3) 66 capacity, $14,000; (4) 78 capacity, $25,500.

***Adjusted totals as of February 24, 1978.

the board of education affecting transportation costs is the density of transported pupils. The density of transported pupils can be measured either in terms of number of transported pupils per lineal mile of bus route or number of transported pupils per square mile of area served. The density of transported pupils per lineal mile of bus route is the better measure of density because it reflects variations in density which cause variations in cost better than density measured by pupils per square mile. It is obvious that the more pupils a bus picks up per mile of route, the less the cost per pupil. This is a good example of economy of scale. Forty years ago, the percent of hard surfaced roads over which school buses operated had some effect on costs of transportation. This was a factor beyond the control of boards of education. However, at the present time almost all of the mileage over which school buses operate is hard surfaced. Therefore this has ceased to be a significant factor beyond the control of boards of education which affects transportation costs. Density of transported pupils is about the only factor beyond the control of boards of education which significantly affects transportation costs.

Following are some of the principal factors within the control of boards of education which cause variations in the per pupil costs of transportation.

1. Efficiency of bus routing,
2. Number of non-handicapped pupils transported who live less than 1½ miles from school,
3. The extent of the use of school buses for educational trips,
4. The extent of the use of school buses for extra-curricular activities,

5. The salaries paid school bus drivers,
6. The efficiency of school bus maintenance,
7. Purchasing procedures,
8. The selection and training of school bus drivers.

It is beyond the scope of this study to make an analysis of the impact of each of these controllable factors on costs of transportation in Tennessee. However Table 2 presents some data on managerial factors affecting school costs, and one factor beyond the control of boards of education, density of transported pupils, which affects transportation costs. Let us compare Perry, the county with the highest per pupil cost with Campbell, the county with the lowest per pupil cost. Perry had a per pupil cost of $150.34 in 1976-77 and Campbell, $55.64. The density of transported pupils per bus route mile (one way) is 1.63 in Perry County and 5.00 in Campbell County. Campbell, the county with a high density is able to serve 128 pupils per bus by using large buses for more than one route. Perry with the lowest density in the state serves only 47 pupils per bus with small buses serving probably one route each. Variations in density of transported pupils per mile of bus route no doubt accounts for most of the variation between these two counties in per pupil cost of transportation. Each of these counties contract for their school transportation.

However, much of the variation in per pupil cost of transportation is not caused by variations in density of transported pupils. An example is Anderson with a density of 3.21 pupils per route mile as compared with Blount with a density of 3.17 per route mile. But the cost per pupil was $97.12 in Anderson as compared with $71.93 in Blount, a county with almost

TABLE 2

SOME FACTORS CAUSING VARIATIONS IN THE PER PUPIL COST OF TRANSPORTATION 1976-77*

1 County (Including City Districts)	2 Number of Buses	3 Cost Per Bus (Includes Depreciation on District Owned Buses)	4 Average Salary Bus Drivers (County Owned Buses)	5 Average Route Mileage Per Bus (One Way)	6 Number Pupils Transported Per Bus	7 Density Pupils Transported Per Route Mile	8 Cost Per Pupil Transported
1. Anderson	97	$8,881		28	91	3.21	97.12
2. Bedford	56	5,039	$1,979	21	65	3.17	77.12
3. Benton	29	7,193		28	86	3.09	83.60
4. Bledsoe	26	6,485		22	61	2.73	106.92
5. Blount	74	9,781		43	137	3.17	71.93
6. Bradley	58	9,262		37	128	3.46	72.36
7. Campbell	48	7,137		27	128	5.00	55.64
8. Cannon	27	5,320		19	48	2.54	110.91
9. Carroll	54	6,177	2,374	25	76	3.04	80.82
10. Carter	78	5,959	2,425	25	85	3.36	70.38
11. Cheatham	46	6,234	2.443	21	82	3.99	75.68
12. Chester	25	6,791	2,588	24	87	3.57	78.01
13. Claiborne	55	62.94		70	73	2.47	75.14
14. Clay	22	6,426	2.359	26	65	2.53	98.99
15. Cocke	55	8,065	2,303	31	78	2.50	103.73
16. Coffee	41	5,806	2,371	26	68	2.54	85.61
17. Crockett	26	5,346	1,506	25	86	3.45	61.82
18. Cumberland	54	6,866	3,144	28	82	2.97	83.87
19. Davidson	384	13,433	6,278	41	98	2.41	136.54
20. Decatur	23	7,553		23	72	3.14	104.33
21. DeKalb	35	5,792	2,122	20	63	3.18	92.64
22. Dickson	59	7,067	3,043	28	80	2.91	87.94
23. Dyer	46	6,137	1,878	21	69	3.30	88.52
24. Fayette	60	7,714	2,479	47	85	1.82	90.28

TABLE 2 (continued)

1 County (Including City Districts)	2 Number of Buses	3 Cost Per Bus (Includes Depreciation on District Owned Buses)	4 Average Salary Bus Drivers (County Owned Buses)	5 Average Route Mileage Per Bus (One Way)	6 Number Pupils Transported Per Bus	7 Density Pupils Transported Per Route Mile	8 Cost Per Pupil Transported
25. Fentress	34	5,697		15	47	3.11	68.00
26. Franklin	53	7,068		32	92	2.85	76.67
27. Gibson	57	7,710	3,026	35	93	2.69	82.67
28. Giles	67	7,160	3,264	25	56	2.25	127.65
29. Grainger	40	4,842		27	76	2.76	65.10
30. Greene	99	6,626		26	90	3.42	73.76
31. Grundy	23	8,381	3,078	26	88	3.40	95.47
32. Hamblen	40	7,644	2,463	29	129	4.51	59.45
33. Hamilton	219	11,525		42	120	2.87	95.80
34. Hancock	35	3,022		14	33	2.42	91.33
35. Hardeman	63	6,161	2,296	25	67	2.68	92.35
36. Hardin	54	6,119	2,748	27	62	2.29	99.11
37. Hawkins	87	6,066	2,380	26	83	3.24	72.90
38. Haywood	53	5,960		39	74	1.88	80.09
39. Henderson	38	6,425		38	81	2.11	79.66
40. Henry	63	7,264	2,642	30	63	2.06	116.00
41. Hickman	42	7,252	3,661	30	61	2.01	119.63
42. Houston	12	7,393	2,218	33	98	2.93	75.63
43. Humphreys	43	6,415	2,270	31	66	2.12	96.99
44. Jackson	24	6,116		27	68	2.48	89.67
45. Jefferson	47	7,167	3,159	30	119	3.99	60.44
46. Johnson	38	6,507	2,182	25	65	2.57	100.88
47. Knox	221	9,089		34	144	4.22	63.33
48. Lake	13	6,755	2,041	20	70	3.59	96.60
49. Lauderdale	45	5,[illegible]34	2,052	30	91	3.09	58.35
50. Lawrence	69	6,615	3.004	29	72	2.50	92.40
51. Lewis	23	4,955	2,035	12	56	4.73	88.55
52. Lincoln	58	5,996	2,266	25	58	2.37	103.49

TABLE 2 (continued)

1 County (Including City Districts)	2 Number of Buses	3 Cost Per Bus (Includes Depreciation on District Owned Buses)	4 Average Salary Bus Drivers (County Owned Buses)	5 Average Route Mileage Per Bus (One Way)	6 Number Pupils Transported Per Bus	7 Density Pupils Transported Per Route Mile	8 Cost Per Pupil Transported
53. Loudon	28	9,871		40	120	1.50	83.53
54. McMinn	75	6,109	2,147	20	86	4.25	70.86
55. McNairy	53	7,245		40	75	1.90	[illegible].39
56. Macon	48	5,240	1,056	22	51	2.32	102.65
57. Madison	87	7,347		17	77	4.46	95.96
58. Marion	35	9,346		43	93	2.35	100.83
59. Marshall	41	6,082	2,226	23	55	2.38	111.02
60. Maury	69	6,448	2,925	20	91	4.66	70.51
61. Meigs	16	6,234	2,369	23	91	2.77	68.17
62. Monroe	46	8,296		30	83	2.78	100.21
63. Montgomery	123	6,878	2,717	28	96	3.49	71.49
64. Moore	14	5,479	2,007	26	60	2.27	91.74
65. Morgan	37	6,718	3,081	15	80	5.22	83.82
66. Obion	58	5,255	2,010	22	58	2.42	98.32
67. Overton	45	5,861		28	68	2.43	86.77
68. Perry	18	7,016		29	47	1.63	150.34
69. Pickett	15	4,937	2,252	22	50	2.24	99.66
70. Polk	39	8,036		29	66	2.25	121.56
71. Putnam	67	5,252	1,895	20	73	3.64	72.41
72. Rhea	43	6,002	2,141	21	72	3.51	83.03
73. Roane	68	6,945	3,191	22	76	3.45	91.88
74. Robertson	61	6,205	2,446	20	84	4.31	73.64
75. Rutherford	83	8.323		38	125	3.27	66.55
76. Scott	41	7.052		34	91	2.70	77.22
77. Sequatchie	19	8,447	2,741	22	80	3.70	105.93
78. Sevier	92	5,666	2,184	24	63	2.70	89.32
79. Shelby	507	11,216		27	78	2.91	143.77

TABLE 2 (continued)

1 County (Including City Districts)	2 Number of Buses	3 Cost Per Bus (Includes Depreciation on District Owned Buses)	4 Average Salary Bus Drivers (County Owned Buses)	5 Average Route Mileage Per Bus (One Way)	6 Number Pupils Trans-ported Per Bus	7 Density Pupils Trans-ported Per Route Mile	8 Cost Per Pupil Trans-ported
80. Smith	33	6,729	2,946	29	68	2.34	98.38
81. Stewart	30	6,216		24	53	2.21	121.91
82. Sullivan	135	8,730		23	123	5.24	71.05
83. Sumner	152	6,709	2,228	19	88	4.67	76.01
84. Tipton	65	6,602	2,455	25	89	3.58	74.20
85. Trousdale	20	4,731	1,704	22	49	2.20	97.14
86. Unicoi	19	5,970	2,257	9	88	10.44	67.48
87. Union	26	7,139		29	86	2.97	83.31
88. Van Buren	12	6,275	2,558	36	70	1.93	90.17
89. Warren	58	6,252	2,565	28	84	3.01	74.78
90. Washington	140	4,757	2,404	13	72	5.41	66.01
91. Wayne	41	6,233	2,730	29	63	2.19	98.17
92. Weakley	66	4,833	1,753	22	52	2.41	93.56
93. White	43	5,510	2,395	26	72	2.76	76.94
94. Williamson	91	6,204	2,199	13	72	5.67	86.04
95. Wilson	86	6,678	2,668	19	79	4.26	84.78

*Data obtained from or computed from data provided in the reports of the State Department of Education.

the same density. This variation is primarily due to the number of pupils served per bus in each county. Column 6 of Table 2 shows that Anderson is serving 91 pupils per bus and Blount is serving 137 pupils per bus. Column 5 of Table 2 shows that the average bus in Anderson County is operating on 28 miles of bus route (one way) while the average bus is operating on 43 miles of bus route in Blount. Evidently a much higher percentage of the buses in Blount County are operating on two or more routes than in Anderson County. These comments should not be interpreted as praising Blount County for its low costs and criticizing Anderson County for its higher costs. This comparison is presented solely for explaining the variation in per pupil cost of transportation between these two counties due to factors other than density of transported pupils.

Variations in per pupil cost of transportation among counties which own their school buses may be caused by variations in the salary paid school bus drivers. For example: Davidson and Weakley have the same density of 2.41 pupils per route mile. But Davidson pays its bus drivers an annual salary of $6,278 and Weakley an annual salary of $1,753. The cost per pupil transported in Davidson County in 1976-77 was $136.54 and in Weakley County it was $93.56. Variations in the salaries paid bus drivers no doubt accounted for most of the variations between these two counties in per pupil costs.

There are four metropolitan counties in Tennessee that transport 26,000 or more pupils. Certain facts concerning those counties are presented in Table 3. Let us compare Hamilton County with Shelby County. The density of transported pupils is similar in both counties: 2.87 in Hamilton and 2.91 in Shelby. But the cost per pupil was $95.80 in 1976-77

TABLE 3

FOUR METROPOLITAN COUNTIES IN TENNESSEE

County	ADA of transported pupils	Annual cost per bus	Average route mileage per bus (one way)	Number of pupils transported per bus	Density of pupils transported per route mile	Cost per pupil transported
Davidson	37,776	13,433	41	98	2.41	136.54
Hamilton	26,334	11,525	42	120	2.87	95.80
Knox	31,716	9,089	34	144	4.22	63.33
Shelby	39,550	11,216	27	78	2.91	143.77

in Hamilton County and $143.77 in Shelby. The total cost per bus was almost the same in these two counties. But Hamilton County operated its buses an average of 41 route miles per bus and Shelby County only 27 miles. Furthermore Hamilton County served 120 pupils per bus and Shelby only 78 pupils. These two managerial factors no doubt account for most of the variation in per pupil costs of transportation between these two counties.

Knox has a much higher pupil density per route mile than the other three metropolitan counties. This accounts in large part for the low per pupil cost in that county. The high density of Knox County made it possible for that county to serve 144 pupils per bus which greatly reduced transportation costs.

The high cost per pupil in Davidson County seems to be largely due to the high average salary paid bus drivers and the fewer pupils served per bus than in Hamilton and Knox counties. The high cost in Shelby County seems to be primarily due to the small number of pupils served per bus.

DEVELOPING A FORMULA FOR THE ALLOCATION OF STATE FUNDS FOR SCHOOL TRANSPORTATION

The primary purpose of this study is to provide an improved formula for the allocation of state funds for school transportation in Tennessee. A desirable formula for allocating state funds for school transportation should provide for:

1. An equitable distribution of state funds for all pupils who need transportation.
2. Sufficient funds to provide a system of school bus operation that is safe, efficient, adequate and economical.
3. Variations in transportation costs per pupil due to factors beyond the control of boards of education but it should not provide for variations in per pupil costs due to factors which boards can control.
4. Relatively easy adjustment to compensate for inflation.
5. A relatively simple formula with limited steps in computing the allocation of state funds for transportation.[2]

As has already been pointed out, variations in density of transported pupils is the principal factor beyond the control of boards of education which causes unavoidable variations in the cost per pupil transported. All equitable formulas for the allocation of state funds for transportation use some measure of density of transported pupils. Two principal measures of density have been used in allocating state funds for transportation. Those measures are number of pupils transported per lineal mile of bus route and number of pupils per square mile in the district. Number of transported pupils per lineal mile of bus route is the better measure of

density because it reflects variations in necessary costs more quickly than density measured in square miles. For example, if a district finds it necessary to use very small capacity buses in order to transport handicapped pupils to centers where they can be served, bus route mileage is increased more than pupils transported and the density of the district decreases which increases the state allocation per pupil transported if lineal density is used. Such a district needs additional funding because the transportation of handicapped pupils in small buses is very expensive. If pupils per square mile is used as the measure of density in that district its density would not decrease and it would receive no additional state funds per pupil, despite increased costs.

The relationship between cost per pupil transported and density of transported pupils is curvilinear, rather than straight line. This is true of practically all economy of scale relationships. Variations in the per pupil costs due to density of transported pupils is essentially an economy of scale relationship.

Formula 1

There are a number of curvilinear mathematical equations that could be used to describe the relationship between cost per pupil transported and density of transported pupils. Other things being equal, it is desirable that the simplest equation be used. Following is a very simple curvilinear mathematical equation that is being used in Florida to allocate state funds for school transportation. It will be called Formula No. 1 in this report.

$$Y = \frac{A}{B + X} + C$$

where Y equals the computed allowable cost per pupil transported, A, B and C are computed constants and X the density index. The method of least squares is used to compute the constants A, B and C from known values of actual cost per pupil and density of pupils. The derivation of the equations to use in a computer for determining the values of A, B and C is presented in the appendix of this report.

The formula developed by the method of least squares is as follows:

$$Y = \frac{\$147.2147}{0.6 + X} + \$46.1554$$

where Y equals the predicted cost per pupil or allowable cost per pupil in the state allocation and X is the density of transported pupils per lineal mile. In this formula, density of counties in excess of 5.0 per lineal mile is counted as 5.0. This is due to the fact that maximum economy of scale has been reached in Tennessee at 5.0 transported pupils per lineal mile and therefore there is no correlation between per pupil costs of transportation and pupil density above a density of 5.0 per lineal mile. A recent study in Florida revealed that there was no correlation between density and cost per pupil beyond a density of 4.7 per lineal mile in that state.[3]

In plotting this formula, Y, the cost, is on the Y axis and X, the density, is on the X axis.

Table 4 shows the impact of this formula on the counties of the state. The coefficient of correlation between predicted cost per pupil transported

TABLE 4

IMPACT OF FORMULA 1 ON COUNTIES, INCLUDING CITIES THEREIN
(Based on 1976-77 data)

1	2	3	4	5	6	7
County	Actual Cost Per Pupil Trans-ported	Predicted Cost By Formula 1	Difference	Density of Trans-ported Pupils Per Lineal Mile	ADA of Trans-ported Pupils	Computed Needed Allocation From State Funds
1. Anderson	97.12	84.77	-12.35	3.21	7,041	596,885
2. Bedford	77.12	85.17	8.05	3.17	3,659	311,632
3. Benton	83.60	86.03	2.43	3.09	2,495	214,651
4. Bledsoe	106.92	90.32	-16.60	2.73	1,577	142,439
5. Blount	71.93	85.15	13.22	3.17	10,061	856,739
6. Bradley	72.36	82.45	10.09	3.46	7,423	612,048
7. Campbell	55.64	72.44	16.80	5.00	6,156	445,940
8. Cannon	110.91	92.98	-17.93	2.54	1,295	120,404
9. Carroll	80.82	86.58	5.76	3.04	4,127	357,336
10. Carter	70.38	83.36	12.98	3.36	6,593	549,590
11. Cheatham	75.68	78.24	2.56	3.99	3,789	296,449
12. Chester	78.01	81.48	3.47	3.57	2,176	177,305
13. Claiborne	75.14	94.10	18.96	2.47	4,607	433,538
14. Clay	98.99	93.16	-5.83	2.53	1,428	133,033
15. Cocke	103.73	93.63	-10.10	2.50	4,276	400,383
16. Coffee	85.81	93.00	7.19	2.54	2,774	257,982
17. Crockett	61.82	82.48	20.66	3.45	2,248	185,407
18. Cumberland	83.87	87.41	3.54	2.97	4,420	386,352
19. Davidson	136.54	95.02	-41.52	2.41	37,776	3,589,369
20. Decatur	104.33	85.50	-18.83	3.14	1,665	142,360
21. DeKalb	92.64	85.10	-7.54	3.18	2,188	186,196
22. Dickson	87.94	88.09	.15	2.91	4,741	417,646

TABLE 4 (continued)

1 County	2 Actual Cost Per Pupil Trans-ported	3 Predicted Cost By Formula 1	4 Difference	5 Density of Trans-ported Pupils Per Lineal Mile	6 ADA of Trans-ported Pupils	7 Computed Needed Allocation From State Funds
23. Dyer	88.52	83.86	-4.66	3.30	3,189	267,422
24. Fayette	90.28	106.89	16.61	1.82	5,127	548,024
25. Fentress	68.00	85.88	17.88	3.11	2,848	244,589
26. Franklin	76.67	88.80	12.13	2.85	4,886	433,866
27. Gibson	82.67	90.86	8.19	2.69	5,316	483,015
28. Giles	127.65	97.85	-29.80	2.25	3,758	367,732
29. Grainger	65.10	89.95	24.85	2.76	3,021	271,741
30. Greene	73.56	82.77	9.21	3.42	8,917	738,080
31. Grundy	95.47	82.92	-12.55	3.40	2,019	167,407
32. Hamblen	59.45	74.96	15.51	4.51	5,143	385,502
33. Hamilton	95.84	88.54	-7.30	2.87	26,334	2,331,706
34. Hancock	91.33	94.86	3.53	2.42	1,158	109,848
35. Hardeman	92.35	91.05	-1.30	2.68	4,203	382,703
36. Hardin	99.11	97.10	-2.01	2.29	3,334	323,723
37. Hawkins	72.96	84.53	11.57	3.24	7,233	611,406
38. Haywood	80.09	105.41	25.32	1.88	3,944	415,743
39. Henderson	79.66	100.55	20.89	2.11	3,065	308,179
40. Henry	116.00	101.54	-14.46	2.06	3,945	400,587
41. Hickman	119.63	102.61	-17.02	2.01	2,546	261,233
42. Houston	75.63	87.92	12.29	2.93	1,173	103,126
43. Humphreys	96.99	100.26	3.27	2.12	2,844	285,146
44. Jackson	89.67	93.89	4.22	2.48	1,637	153,697
45. Jefferson	60.44	78.25	17.81	3.99	5,573	436,106
46. Johnson	100.88	92.65	-8.23	2.57	2,451	227,077
47. Knox	63.33	76.69	13.36	4.22	31,716	2,432,362
48. Lake	96.60	81.27	-15.33	3.59	909	73,871
49. Lauderdale	58.35	86.07	27.72	3.09	4,113	354,024

TABLE 4 (continued)

1 County	2 Actual Cost Per Pupil Trans-ported	3 Predicted Cost By Formula 1	4 Difference	5 Density of Trans-ported Pupils Per Lineal Mile	6 ADA of Trans-ported Pupils	7 Computed Needed Allocation From State Funds
50. Lawrence	92.40	93.66	1.26	2.50	4,940	462,697
51. Lewis	88.55	73.77	-14.78	4.73	1,287	94,938
52. Lincoln	103.49	95.79	-7.70	2.37	3,360	321,841
53. Loudon	83.53	116.40	32.87	1.50	3,349	389,822
54. McMinn	70.86	76.52	5.66	4.25	6,465	494,723
55. McNairy	96.39	105.12	8.73	1.90	3,983	418,692
56. Macon	102.65	96.57	-6.08	2.32	2,450	236,597
57. Madison	95.96	75.23	-20.73	4.46	6,660	501,014
58. Marion	100.83	96.05	-4.78	2.35	3,244	311,574
59. Marshall	111.02	95.49	-15.53	2.38	2,246	214,460
60. Maury	70.51	74.16	3.65	4.66	6,310	467,948
61. Meigs	68.17	89.83	21.66	2.77	1,463	131,419
62. Monroe	100.21	89.74	-10.47	2.78	3,808	341,737
63. Montgomery	71.49	82.18	10.69	3.49	11,832	972,390
64. Moore	91.74	97.53	5.79	2.27	836	81,534
65. Morgan	83.82	72.44	-11.38	5.22*	2,965	214,785
66. Obion	98.32	94.96	-3.36	2.42	3,100	294,386
67. Overton	86.77	94.72	7.95	2.43	3,039	287,860
68. Perry	150.34	112.23	-38.11	1.63	840	94,276
69. Pickett	99.66	97.91	-1.75	2.24	743	72,744
70. Polk	121.56	97.78	-23.78	2.25	2,578	252,082
71. Putnam	72.41	80.88	8.47	3.64	4,859	392,987
72. Rhea	83.03	81.96	-1.07	3.51	3,108	254,725
73. Roane	91.88	82.55	-9 33	3.45	5,140	424,303
74. Robertson	73.64	76.15	2.51	4.31	5,140	391,397
75. Rutherford	66.55	84.16	17.61	3.27	10,379	873,547

TABLE 4 (continued)

1 County	2 Actual Cost Per Pupil Trans-ported	3 Predicted Cost By Formula 1	4 Difference	5 Density of Trans-ported Pupils Per Lineal Mile	6 ADA of Trans-ported Pupils	7 Computed Needed Allocation From State Funds
76. Scott	77.22	90.83	13.61	2.70	3,744	340,057
77. Sequatchie	105.93	80.43	-25.50	3.70	1,515	121,852
78. Sevier	89.32	90.71	1.39	2.70	5,836	529,366
79. Shelby	143.77	88.05	-55.72	2.91	39,550	3,482,503
80. Smith	98.38	96.21	-2.17	2.34	2,257	217,138
81. Stewart	121.96	98.61	-23.35	2.21	1,529	150,779
82. Sullivan	71.05	72.44	1.39	5.24*	16,585	1,201,417
83. Sumner	76.01	74.07	-1.94	4.67	13,416	993,780
84. Tipton	74.20	81.40	7.20	3.58	5,783	470,764
85. Trousdale	97.14	98.66	1.52	2.20	974	96,099
86. Unicoi	67.48	72.44	4.96	10.44*	1,681	121,772
87. Union	83.31	87.43	4.12	2.97	2,228	194,794
88. Van Buren	90.17	104.28	14.11	1.93	835	87,071
89. Warren	74.78	86.96	12.18	3.01	4,849	421,654
90. Washington	66.01	72.44	6.43	5.41*	10,089	730,846
91. Wayne	98.17	98.87	.70	2.19	2,603	257,346
92. Weakley	93.56	95.09	1.53	2.41	3,420	325,205
93. White	76.94	89.95	13.01	2.76	3,079	276,958
94. Williamson	86.04	72.44	13.60	5.67*	6,562	475,351
95. Wilson	84.78	76.46	-8.32	4.26	6,774	517,945
						43,937,785

*Density above 5.0 is computed as a density of 5.0.

and actual cost per pupil is .5469. The author of this study has made studies of the relationship between per pupil cost of transportation and predicted cost in a number of states. The correlation in Tennessee is the lowest found in any state studied. This indicates that factors controllable by boards of education are a major cause of variations among the counties in the cost per pupil transpo[illegible]l. No equitable formula could or should take into account variation[illegible]g school districts in per pupil costs of transportation due to factors [illegible]ch are subject to the control of boards of education.

Formula No. 1 predicts the allowable cost per pupil transported in terms of the average cost per pupil in districts with a similar density. Thus the formula tends to reward efficiency and penalize inefficiency. Under this formula, a district which spends more money per pupil transported than the average district with a similar density will need to fund the excess expenditure from local revenue. On the other hand, if a district spends less per pupil transported than the state allocation per pupil, the district can spend its excess revenue for enriching its educational program.

It is noted from Table 4 that the computed state allocation needed for transportation was $43,937,785 in 1976-77 as compared with a total cost of $46,168,051 as shown in Table 1. This is due to the fact that the expenditures per pupil transported in two large counties, Shelby and Davidson, were so much in excess of other counties with a similar density that no defensible formula treating all counties equitably could possibly fund actual expenditures in those two counties. It might be concluded that the cost of living is higher in Shelby and Davidson than in other counties

of the state with similar densities. However Knox and Hamilton counties are also metropolitan counties and there is no reason to believe that the cost of living is significantly higher in Shelby and Davidson than in Knox and Hamilton. Table 4 shows that Knox County spends less per pupil transported than other counties of similar density and Hamilton only slightly more. It is beyond the scope of this study to determine the relationship, if any, between variations among the counties of Tennessee in cost of living and variations in per pupil costs of transportation.

Formula No. 1 was also applied to the Tennessee data using density of transported pupils per square mile as the measure of density instead of density of pupils per lineal mile. The coefficient of correlation between density of transported pupils per square mile and per pupil cost of transportation was found to be .5194. This is less than the correlation of .5469 between lineal density and per pupil cost of transportation, therefore, density measured by transported pupils per lineal mile of bus route is a better measure than density of transported pupils per square mile.

Formula No. 2

This formula was used by Stollar and Tanner in a report prepared for the Tennessee Tax Modernization and Reform Commission in June 1973.[4] Hereafter in this report it will be designated as Formula No. 2. It is as follows:

$$Y = a + a_1 X_1 + a_2 X_1^2$$

where Y equals predicted per pupil cost; a, a_1 and a_2 are computed constants and X_1 is density of transported pupils per route mile. This equation is curvilinear and has characteristics similar to Formula No. 1. It was applied to Tennessee data for 1976-77. The cost data included operating costs plus depreciation the same as used in the computations for Formula No. 1.

The computations for Formula No. 2 produced the following equation:

$$Y = \$136.6018 - \$20.1876\ X_1 + \$1.3430\ X_1^2$$

Lineal density of counties in excess of 5.0 pupils per route mile was counted as 5.0 the same as under Formula No. 1.

The correlation between predicted per pupil cost of transportation and actual per pupil cost by Formula No. 2 was .5447. This is not significantly different from the correlation of Formula No. 1 which was .5469. The correlation for Formula No. 1 was only slightly higher than for Formula No. 2.

Table No. 5 compares the predicted per pupil costs by both formulas. It is observed that the predicted costs of the two formulas are very highly correlated. Actually it would make very little difference which formula is used.

The question has been raised concerning adequate provision for the extra cost of transporting handicapped pupils in small buses. However these small buses increase the route mileage of a county and decrease its density thereby increasing the state allocation per pupil under both

TABLE 5

COMPARISON OF PREDICTED COST PER PUPIL BY FORMULA 1
AND BY FORMULA 2 - 1976-77 DATA

County	Formula 1*	Formula 2**	County	Formula 1*	Formula 2**
1. Anderson	$84.77	$85.61	28. Giles	$97.85	$98.01
2. Bedford	85.17	86.06	29. Grainger	89.95	91.10
3. Benton	86.03	87.03	30. Greene	82.11	83.26
4. Bledsoe	90.32	91.46	31. Grundy	82.92	84.44
5. Blount	85.15	86.05	32. Hamblen	74.96	72.86
6. Bradley	82.45	82.88	33. Hamilton	88.54	89.69
7. Campbell	72.44	69.23	34. Hancock	94.86	95.58
8. Cannon	92.98	93.93	35. Hardeman	91.05	92.16
9. Carroll	86.58	87.62	36. Hardin	97.10	97.42
10. Carter	83.36	83.97	37. Hawkins	84.53	85.34
11. Cheatham	78.24	77.45	38. Haywood	105.41	103.33
12. Chester	81.48	81.68	39. Henderson	100.55	100.04
13. Claiborne	94.10	94.93	40. Henry	101.54	100.75
14. Clay	93.16	94.10	41. Hickman	102.61	101.48
15. Cocke	93.63	94.52	42. Houston	87.92	89.04
16. Coffee	93.00	93.95	43. Humphreys	100.26	99.83
17. Crockett	82.48	82.91	44. Jackson	93.89	94.74
18. Cumberland	87.41	88.51	45. Jefferson	78.25	77.47
19. Davidson	95.02	95.71	46. Johnson	92.65	93.64
20. Decatur	85.50	86.44	47. Knox	76.69	75.32
21. DeKalb	85.10	85.98	48. Lake	81.27	81.41
22. Dickson	88.09	89.22	49. Lauderdale	86.07	87.07
23. Dyer	83.86	84.56	50. Lawrence	93.66	94.54
24. Fayette	106.89	104.25	51. Lewis	73.77	71.15
25. Fentress	85.88	86.86	52. Lincoln	95.79	96.35
26. Franklin	88.80	89.95	53. London	116.40	109.41
27. Gibson	90.86	91.98	54. McMinn	76.52	75.08

TABLE 5 (continued)

County	Formula 1*	Formula 2**	County	Formula 1*	Formula 2**
55. McNairy	105.12	103.14	76. Scott	90.83	91.94
56. Macon	96.57	96.99	77. Sequatchie	80.43	80.34
57. Madison	75.23	73.25	78. Sevier	90.71	91.83
58. Marion	96.05	96.57	79. Shelby	88.05	89.18
59. Marshall	95.49	96.10	80. Smith	96.21	96.70
60. Maury	74.16	71.72	81. Stewart	98.61	98.60
61. Meigs	89.83	90.98	82. Sullivan	72.44	69.24
62. Monroe	89.74	90.89	83. Sumner	74.07	71.59
63. Montgomery	82.18	82.55	84. Tipton	81.40	81.58
64. Moore	97.53	97.76	85. Trousdale	98.66	98.64
65. Morgan	72.44	69.24	86. Unicoi	72.44	69.24
66. Obion	94.96	95.66	87. Union	87.43	88.53
67. Overton	94.72	95.46	88. Van Buren	104.28	102.60
68. Perry	112.23	107.30	89. Warren	86.96	88.03
69. Pickett	97.91	98.05	90. Washington	72.44	69.24
70. Polk	97.78	97.96	91. Wayne	98.87	98.79
71. Putnam	80.88	80.92	92. Weakley	95.09	95.77
72. Rhea	81.96	82.27	93. White	89.95	91.10
73. Roane	82.55	82.99	94. Williamson	72.44	69.24
74. Robertson	76.15	74.55	95. Wilson	76.46	75.00
75. Rutherford	84.16	84.91			

*Formula 1: Density above 5.0 is computed as a density of 5.0.

**Formula 2: Density above 5.0 is computed as a density of 5.0.

formulas. Regardless of which formula is used, the equations should be recomputed annually in order to reflect changes in per pupil costs. For example, Stollar and Tanner based their computations on 1971-72 data when the operating cost of school transportation was $44.16 per pupil as compared with $79.48 in 1976-77. No one can predict with accuracy increases in transportation costs in the future resulting from increases in the cost of living and increases in the price of fuel. Throughout the nation, the cost per pupil of transportation has been rising more rapidly than the consumer price index. It would be possible to use either Formula 1 or Formula 2 for three or four years without recomputation by increasing the predicted needed allocation per pupil by as much as the per pupil cost of transportation increases in the state. For example, if the per pupil cost of transportation increased 7 percent in the state, the formula allocation for each county could be increased by 7 percent. However, this would not be as satisfactory as recomputing the equation annually. Computer programs have already been developed for computing the equation for both Formula 1 and Formula 2 and the computation can be accomplished very quickly.

The total defensible costs of transportation as determined by either Formula 1 or Formula 2 should be included in the state's foundation program. To do otherwise would be a discrimination against the counties which are compelled to spend a higher percent of their budgets for transportation than the state average. Furthermore, school transportation is a necessary part of the state educational program and vital to the equalization of educational opportunity. There is no valid reason for not funding school

transportation in the state's financial program as adequately as any other part of the educational program.

It is noted that both Formula 1 and Formula 2 allocate state funds to the counties including the city school systems therein. The present law allocates transportation funds between the county and the city school systems therein in proportion to the number of students transported. It is possible that these costs may differ within the county but data available are not sufficient to develop a better plan for allocating transportation funds between a county and the city systems therein than the plan provided in the present law.

Formula No. 3

This formula is the one in the present laws of Tennessee. Formula No. 3 is as follows: 60 percent of the state funds appropriated for school transportation shall be allocated on a per student transported basis and 40 percent shall be allocated on the basis of the ratio of the geographical area of each county to the total geographical area of the state as computed in square miles. Formula No. 3 was applied to the distribution of the total funds allocated under Formula 1. That total as shown in Table 4 was $43,937,785. The allocation under Formula 3 was computed in terms of predicted cost or state allocation per pupil transported and correlated with actual costs. The correlation for Formula 3 was found to be .5005 as compared with .5469 for Formula 1 and .5447 for Formula 2. Therefore the present state formula, Formla 3, is not as equitable as Formulas 1 and 2. Incidentally, Formula 3 would allocate only $59.74 per pupil in Shelby County and $57.51 per pupil in Davidson County out of a total state

appropriation of $43,937,785. On the other hand, Formula No. 3 out of this sum would allocate $127.04 per transported pupil to Hardin County and $151.75 to Hickman County. A comparison of the amounts allocated for these four counties by Formula 1 as shown in Table 4 reveals that Formula 3, in general, under allocates to metropolitan counties and over allocates to counties transporting a small number of pupils.

Other Formulas

A number of other formulas were tested by computer simulation and none was found to be as satisfactory as Formulas 1 and 2.

RECOMMENDATIONS

The following recommendations are respectfully submitted:

1. The state of Tennessee should adopt either Formula 1 or Formula 2 for the allocation of state funds for school transportation.

2. Density of transported pupils per mile of bus route one way should be used as the measure of density. Handicapped pupils who need transportation should be provided transportation service regardless of the distance they live from school. The route miles of the small vehicles used to transport handicapped pupils should be counted as bus miles in computing transportation density. Route miles for transporting vocational students and exceptional students from one center to another center in order to have access to the programs needed should also be included as route mileage when computing transporting density.

3. The per pupil allocation by either Formula 1 or Formula 2 should be calculated for either a 175 day of 180 day term as determined by the

Legislature. If a district operates schools more or less than 175 days (or 180), the allocation per student for transportation to such schools should be calculated by multiplying the quotient of the days the schools operate divided by 175 days (or 180) times the allocation per pupil determined by formula for 175 (or 180) days.

4. For reasons pointed out above, the Legislature should include the total defensible cost of transportation in its appropriations for the public schools. If the amount appropriated is less than the amount determined as needed by the formula, the amount allocated to the respective counties should be scaled downward proportionately. The formula expressing need for transportation funding should not be juggled to fit the amount appropriated by the Legislature. It is better policy to scale the amount allocated by formula down to the amount appropriated by the Legislature in case of underfunding because it will reveal to the Legislature the extent to which it is underfunding transportation.

5. There is some evidence in state reports that the accuracy of reporting of transportation costs, route mileage and pupils transported by the school districts of the state could be improved. Some of the variations in computed costs per pupil may be due in part to lack of uniformity in reporting.

FOOTNOTES

1. This figure includes handicapped pupils who live less than 1½ miles from school if they need transportation.

2. Adapted in part from Dewey H. Stollar, "Pupil Transportation," Chapter 9, Planning to Finance Education, Roe L. Johns, Kern Alexander & Forbis Jordan, eds. Gainesville, Fla.: National Educational Finance Project, Vol. 3, 1971, pp. 329-369.

3. Roe L. Johns, State Funding of School Transportation in Florida. Gainesville, Fla.: The Institute for Educational Finance, University of Florida, 1977.

4. Dewey H. Stollar and C. Kenneth Tanner, Part 1, The Financing of Public School Education. Knoxville, Tenn.: Tennessee Tax Modernization and Reform Commission, 1973.

APPENDIX

The purpose of this appendix is to show the technical steps employed in developing a computer program for the equation

$$Y = \frac{A}{B + X_1} + C$$

The purpose of the constant B is to make the curve of the equation tangent to a point in the second quadrant rather than tangent to the Y axis. The purpose of B is to slide the curve back and forth until it best fits the data. The value of B can be determined by experimentation with a computer. It is usually less than 2.0. The value of B for Tennessee was found to be 0.6. If B is made more or less than 0.6, experimentation showed that the correlation between predicted values and actual values was reduced. The equation now becomes

$$Y = \frac{A}{.6 + X} + C$$

1. Since Y is the actual value and $\frac{A}{.6 + X} + C$ is the predicted value, if their difference is found, squared, summed and made a minimum as

$$\Sigma\left(Y - \left(\frac{A}{.6 + X} + C\right)\right)^2$$

equals a minimum, the condition of best fit will be satisfied. This is called the "least squares" method.

2. Differentiating the function with respect to A:

$$\text{(a)} \quad \Sigma f\left(\frac{Y}{.6 + X}\right) = A\Sigma\left(\frac{f}{(.6 + X)^2}\right) + C\Sigma\left(\frac{f}{(.6 + X)}\right)$$

where f equals frequency.

3. Differentiating with respect to C:

$$\text{(b)} \quad \Sigma fy = A\Sigma\left(\frac{f}{.6 + X}\right) + NC \ .$$

4. The equations (a) and (b) are simultaneous equations in two unknowns A and C for the other values f, Y, X and N are known being the original data themselves.